

NASA CR-

141659TECHNICAL NOTE

FOG TESTS PERFORMED AT KENNEDY SPACE CENTER
ON KODAK FILM TYPE 101-05

(NASA-CR-141659) FOG TESTS PERFORMED AT
KENNEDY SPACE CENTER ON KODAK FILM TYPE
101-05 (Technicolor Graphic Services, Inc.)
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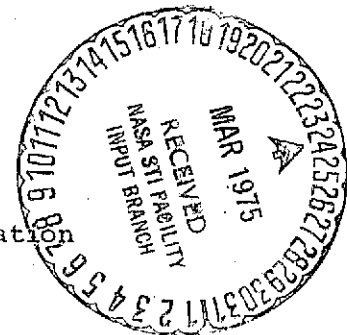
Contract NAS 9-11500
Task Order HT-79

Prepared By

Mark S. Weinstein
Photoscientist

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Photographic Technology Division
National Aeronautics and Space Administration
Lyndon B. Johnson Space Center
Houston, Texas



Technicolor Graphic Services, Inc

FOG TESTS PERFORMED AT KENNEDY SPACE CENTER
ON KODAK FILM TYPE 101-05

This report has been reviewed
and is approved.

SUBMITTED BY:

Mark S. Weinstein
Mark S. Weinstein, Photoscientist

APPROVED:

Gerard E. Sauer
Gerard E. Sauer, Supervisor
Photo Science Office

CONCURRENCE:

Francis J. Engel, Jr.
Francis J. Engel, Jr., Operations Manager
Technicolor Graphic Services, Inc.

APPROVED:

Noel T. Lamar
Noel T. Lamar, Technical Monitor

CONCURRENCE:

John R. Brinkmann
John R. Brinkmann, Chief
Photographic Technology Division

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I. BACKGROUND

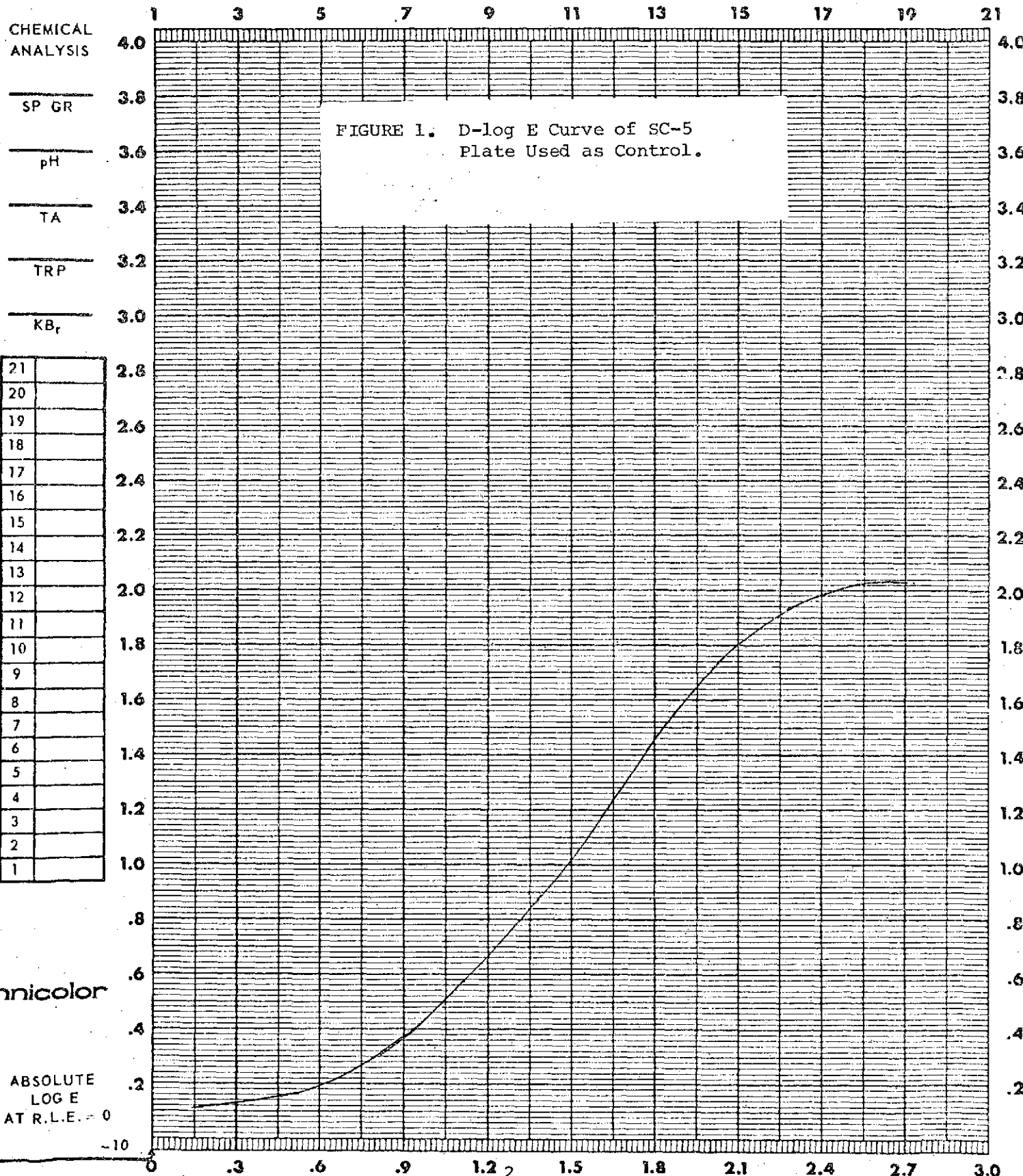
The film used by the S-183 experimenters on SL-2 was type SC-5 glass plates produced by the Kodak Pathe Laboratories in France. Two carrousels, each containing 36 glass plates were flown and returned for processing. One carousel had been launched in the Orbital Workshop (OWS) and saw temperatures as high as 125° F. due to a malfunction of the spacecraft's solar shield. The second carousel was launched in the Command Module and did not see temperatures as high as those experienced by the first carousel. After the mission, a visible daylight sensitometric exposure was applied to an SC-5 glass plate removed from each of the carrousels and to an SC-5 control glass plate which had not flown. All plates were processed in the same manner. The resultant D-log E curves are shown in Figures 1 through 3. The curves for the two glass plates that had flown on the mission are identical and show a large loss in sensitivity and gamma when compared to the control plate. In addition to the sensitometric problems, the emulsion was not adhering properly to the glass plate. Attempts at solving these problems were unsuccessful.

Ed Hahn of the Eastman Kodak Company in Rochester, New York, was contacted to determine if another type of glass plate was available for Skylab 3. Kodak Special Plate Type 101-05 was available, and arrangements were made for the S-183 experimenters to obtain 144 glass plates and handcarry them to France to be loaded into the carrousels for SL/3.

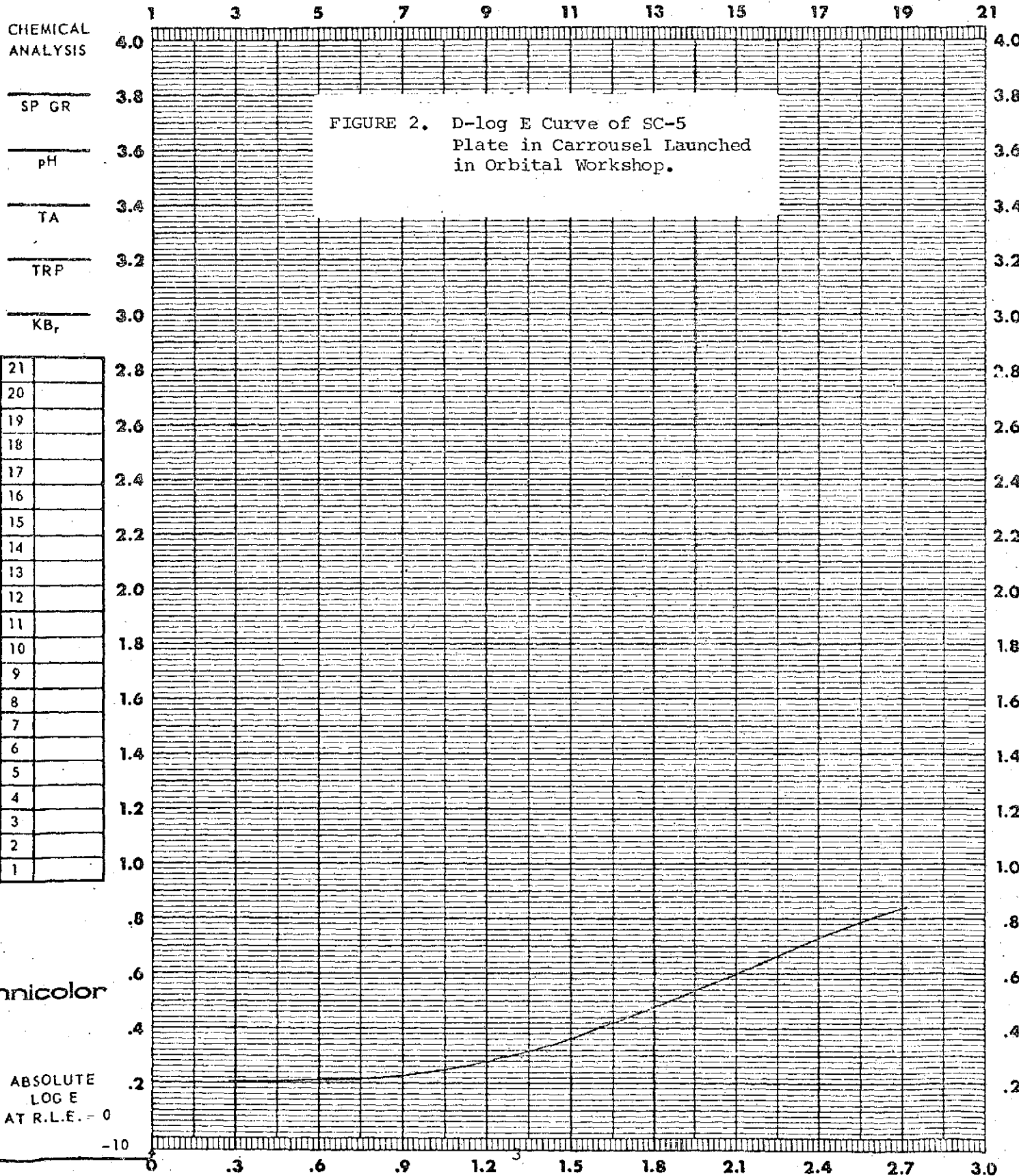
DATE _____ CONTROL # _____ TASK _____ PREPARED BY _____

FILM SC-5 EMULSION # _____ MFG _____ EXPIRATION DATE _____

EXPOSURE DATA		PROCESSING DATA		DENSITOMETRY	
SENSITOMETER	<u>I-B</u>	PROCESSOR	<u>Tank</u>	INSTRUMENT	<u>MacBeth</u>
ILLUMINANT	<u>2850 °K</u>	CHEMISTRY	<u>D19B</u>	TYPE	<u>TD217DR</u>
TIME	<u>1/100</u> SEC.	SPEED	<u>TANKS</u> FPM	APERTURE SIZE	<u>MM</u>
FILTER	<u>5500°K</u>	TEMP °F	<u>68</u> TIME <u>2 min.</u>	FILTER	<u>Visual</u>
				SPEED ()	
				D-MAX	
				GAMMA	
				BASE + FOG	



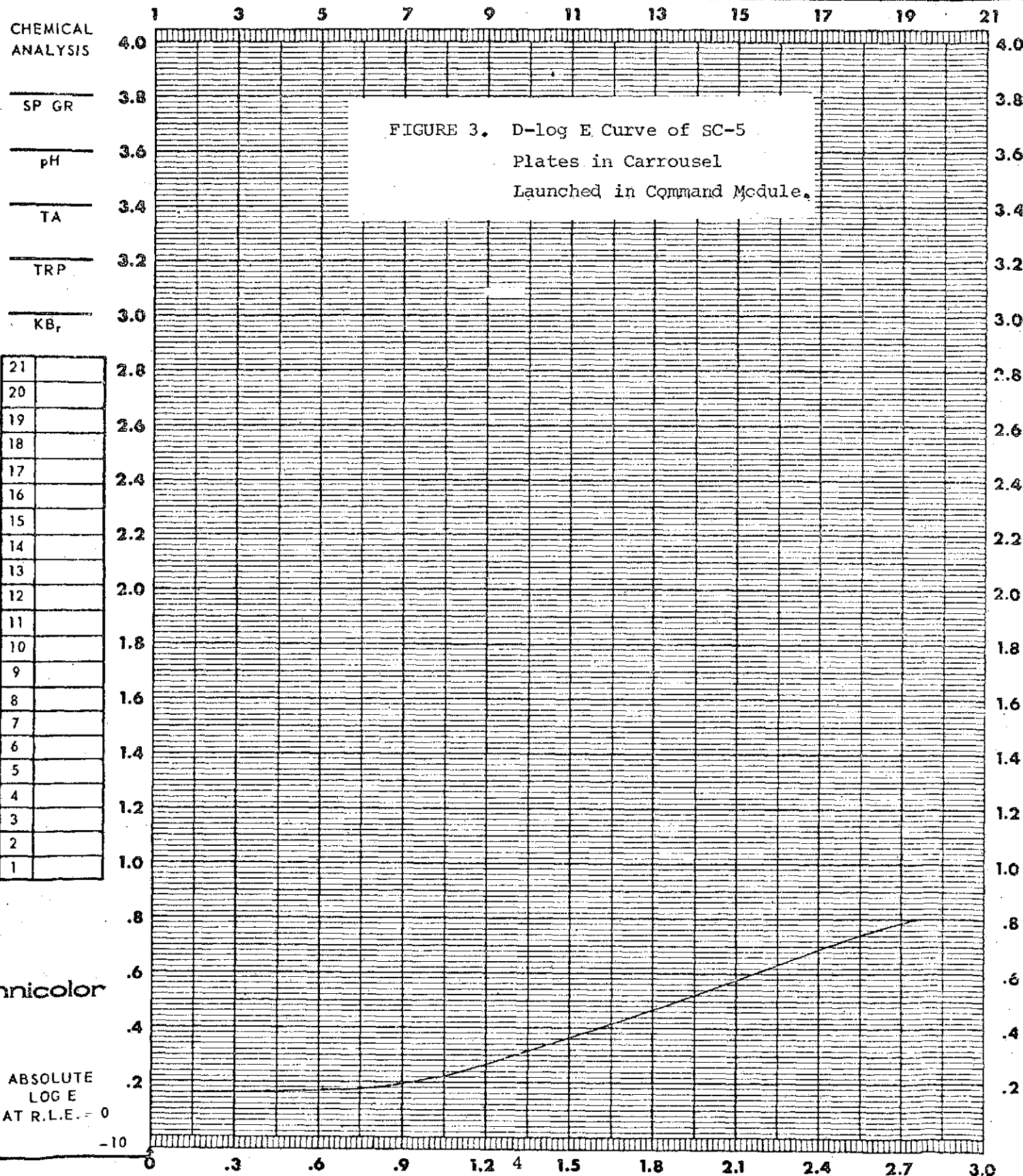
EXPOSURE DATA		PROCESSING DATA		DENSITOMETRY	
SENSITOMETER	<u>T-R</u>	PROCESSOR	<u>Tank</u>	INSTRUMENT	<u>MacBeth</u> SPEED ()
ILLUMINANT	<u>2850 °K</u>	CHEMISTRY	<u>D-19B</u>	TYPE	<u>1044/DS</u> D-MAX
TIME	<u>1/100 SEC.</u>	SPEED	<u>TANKS</u> FPM	APERTURE SIZE	<u>MM</u> GAMMA
FILTER	<u>5500°K</u>	TEMP °F	<u>68</u> TIME <u>2 min.</u>	FILTER	<u>Visual</u> BASE + FOG



DATE _____ CONTROL # _____ TASK _____ PREPARED BY _____

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EXPOSURE DATA		PROCESSING DATA		DENSITOMETRY	
SENSITOMETER	I-B	PROCESSOR	Tank	INSTRUMENT	MacBeth
ILLUMINANT	2850 °K	CHEMIST	D-19B	TYPE	TD217DR
TIME	1/100 SEC.	SPEED	ANKS _____ FPM	APERTURE SIZE	_____ MM
FILTER	5500°K	TEMP °F	68	TIME	2 min.
				FILTER	Visual
					BASE + FOG



The 101-05 glass plates have approximately the same sensitometric characteristics as the SC-5 plates, but they are not as susceptible to heat and humidity degradation. The 101-05 glass plates are coated using a different technique than that used for the SC-5, possibly alleviating the problem encountered when the SC-5 emulsion separated from the glass support. Also, the 101 emulsion coated on an Estar base was used successfully on SL/2 for the S-019 experiment. These facts led to the decision to switch from SC-5 to 101-05 glass plates.

While loading the glass plates into the carousel at their laboratory in France, the PI discovered the plates were being fogged. After some testing, they concluded the fog was being caused by an aluminum tool used for loading. When the plates were loaded by hand, no fogging occurred. The flight carousels were loaded by hand with 101-05 glass plates and hand-carried from France to the Kennedy Space Center (KSC). Upon arrival at KSC, it was discovered the glass plates were again fogged. On Friday, July 20, 1973, the Skylab Program Office requested the help of the Johnson Space Center Photographic Technology Division (JSC/PTD) in determining how the plates were being fogged. The PTD made arrangements with Dick Madigan, Scientific Photography Representative of the Eastman Kodak Company to obtain a new batch (144) of the 101-05 glass plates. On Saturday, July 21, 1973, a Technicolor photoscience (Mark Weinstein) flew from Houston to Rochester, New York, received the new glass plates from Dick Madigan, and then handcarried them to KSC. Special precautions were taken to insure the film would not be exposed to x-rays. Upon arrival at KSC,

the photoscience met with Marshall Space Flight Center (MSFC) representatives, Mary Jo Smith and Harry Atkins, and the PI, André Vuillemin, to discuss the test plan. Arrangements were made to use the facilities at the KSC Photo Lab operated by Technicolor Graphic Services Inc. to carry out the testing.

II. TEST PROCEDURE

Three carrousels, serial numbers 1-2, 2-1, and 2-2, were available for testing. Carousel 1-2 contained thirty-three glass plates of type 101-05 which had been loaded in France (Batch #1). These were removed and placed in 8" x 10" photographic light-tight boxes. The following narrative describes the performed tests and the results in sequential order:

1. The photoscience (Mark Weinstein) and the PI (André Vuillemin) each removed one of the new glass plates (Batch #2) from its storage box, loaded it by hand into the gold-coated plastic holder, then placed the loaded holder into the carousel, advanced the carousel to position 20, and then back to position 1. The holder was removed from the carousel, and the plate was processed as follows:
 - a. Distilled water pre-soak - 4 minutes at 68°F
 - b. D-19 developer - 4 minutes at 68°F
 - c. Wash - distilled water - 20 seconds at 68°F
 - d. Fixer - 4 minutes at 68°F
 - e. Wash - tap water - 20 minutes at 68°F
 - f. Air dry - room temperature

This processing procedure was followed throughout the testing program.

Both plates were free of any fogging (Figures 4 and 5).

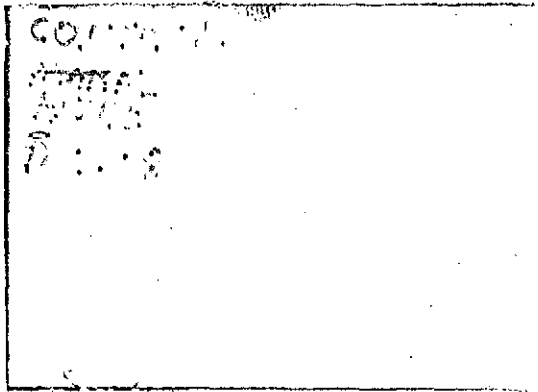


FIGURE 4
Control - Andre

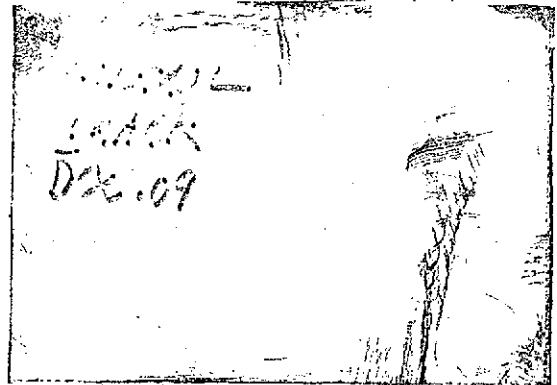


FIGURE 5
Control - Mark

Scratch marks caused by handling are evident on one plate and appear as fine dark lines. This test verified that the plates (Batch #2) were not fogged while being transported from Rochester to KSC, and eliminated most procedural problems, such as light leaks in the darkroom.

2. The amount of time required for plates to fog in the carrousel was unknown. In order to determine if the Batch #2 plates would fog in a carrousel that had fogged plates from Batch #1, and if so, to determine the length of time required for fogging, twenty-four plates were loaded into carrousel 1-2. One plate was to be removed every two hours until fogging occurred. At the same time, eight plates were loaded into carrousel 2-1. They were to be used to analyze

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the difference between carrousels. After loading, both carrousels were returned to their containers and sealed before turning on the lights.

To check for light leaks, two plates were loaded into a third carrousel, serial number 2-2, one plate was placed in position #1 and the other plate was placed in position #18. This carrousel was left out of the container, and the room lights were turned on.

3. After 3 hours had elapsed, a plate was removed from carrousel 1-2 and was processed along with a plate from the first batch which had been loaded in the carrousel in France. The batch #1 plate was removed from the carrousel at KSC just prior to the start of this test program. The plate that had been in for 3 hours, (Figure 6), was partially fogged with the heaviest fog prominent along one edge. The plate from Batch #1 was completely fogged (Figure 7).

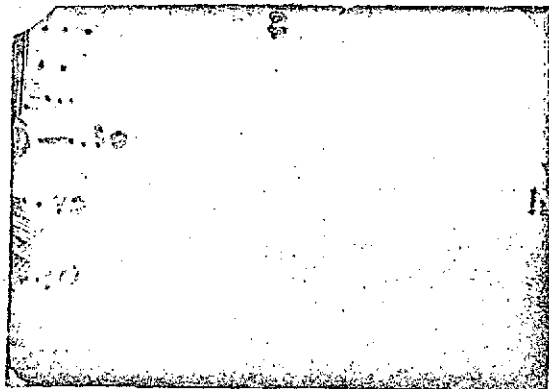


FIGURE 6
Carrousel 1-2
Position 1
3 hours

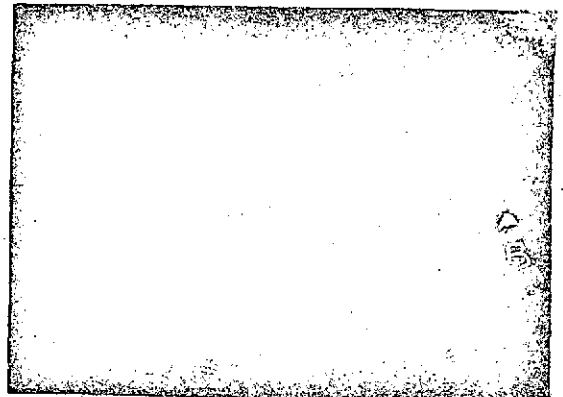


FIGURE 7
Batch #1
101-05

4. To check for differences between carrousels and for the possibility of light leaks, one plate was removed from each carousel, 2-1 and 2-2, and processed (Figures 8 and 9).

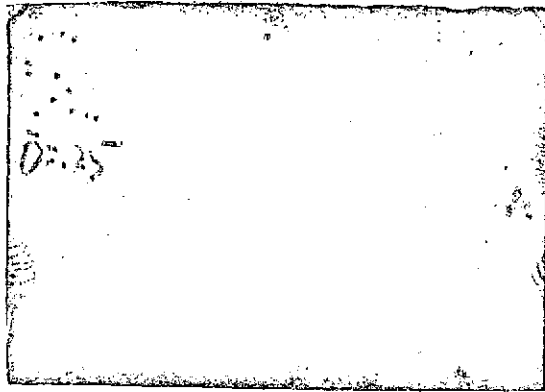


FIGURE 8
Carousel 2-1
Position 1
2 hours

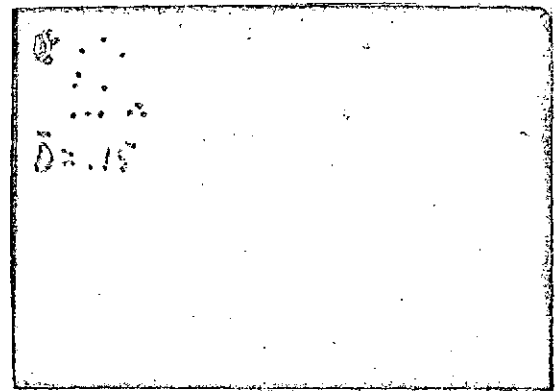


FIGURE 9
Carousel 2-2
Position 1
2.5 hours

Both plates exhibited fog, however, the plate from the 2-1 carousel showed more fog than the plate from the 2-2 carousel. Both plates showed less fog effect than the plate from the 1-2 carousel. (There now seemed to be a difference between carrousels, and though inconclusive, the fog was probably not caused by a light leak, since carousel 2-2 showed less fog than the other carrousels even though the others were sealed in their containers, while the 2-2 carousel was left out.) The plates described thus far had all been stored in position #1.

5. To determine if there was a difference between positions, a plate was removed and processed from position #20,

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carrousel 1-2 (Figure 10) and position #18, Carrousel 2-2 (Figure 11).

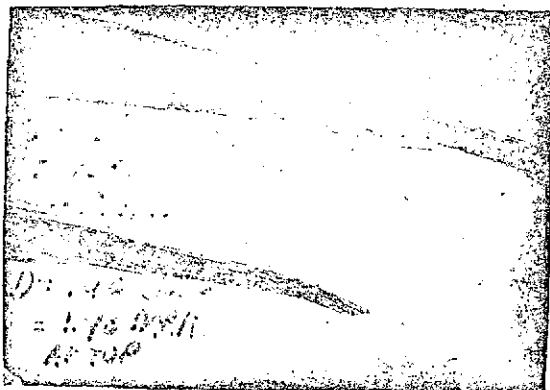


FIGURE 10
Carrousel 1-2
Position 20
3.5 hours

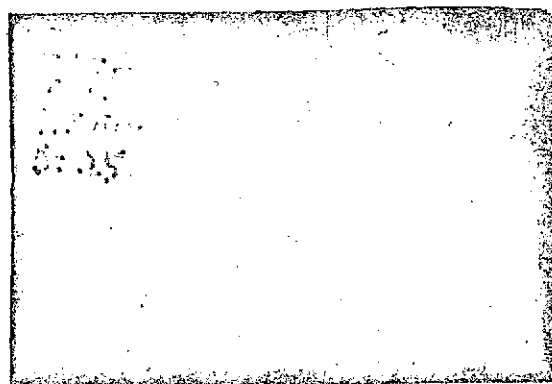


FIGURE 11
Carrousel 2-2
Position 18
3.5 hours

The two dark triangular streaks seen in Figure 10 are scratches caused by handling, and are not the type of fog under test. The white vertical bars seen in Figure 11 (and seen as vertical or horizontal bars on other plates throughout the testing) are probably caused by Kodak during the coating of the emulsion onto the glass plate.

6. The fogging appeared to start at the edges and advance toward the center of the plates. Since the gold-coated holder was supported in the carrousel by two sets of tracks, one being irridited aluminum and the other being brass, it might have been possible for a small

electrical potential to exist between the tracks, conducted by the gold coating on the holder. To check out this possibility, the gold coating was removed from the plastic holder using a scouring pad and water. A plate was inserted into the holder, and the holder was placed in the carrousel at position #1. After 2 hours, the plate was removed and processed (Figure 12). The same type of fogging occurred as previously found.

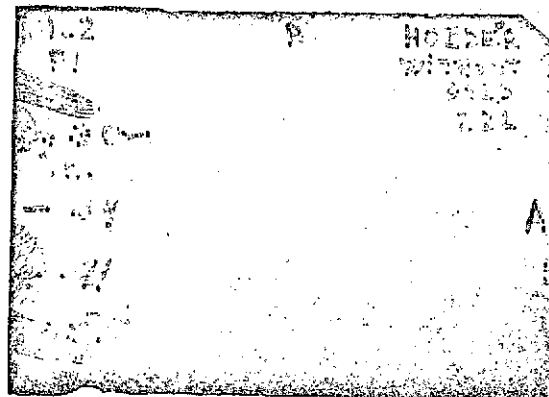


FIGURE 12
Position 1
2 hours
Holder Without Gold

7. A plate that had been in the 2-1 carrousel for 8 hours was processed along with the previously described plate. This plate is shown in Figure 13.

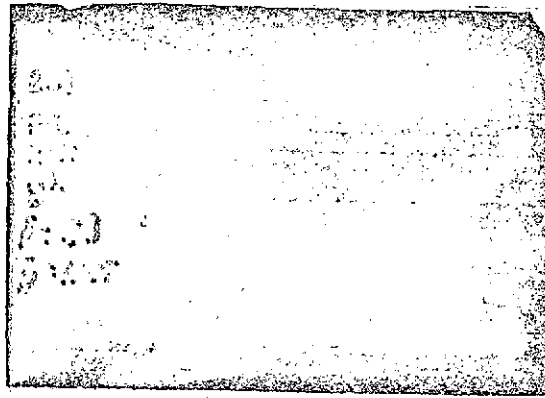


FIGURE 13
Carrousel 2-1
Position 2
8 hours

8. A glass plate was inserted into a gold-coated holder and stored in a light-tight cardboard box to determine if the holder itself was causing the fog. After two hours the plate was removed and processed. There was no evidence of fogging (Figure 14).

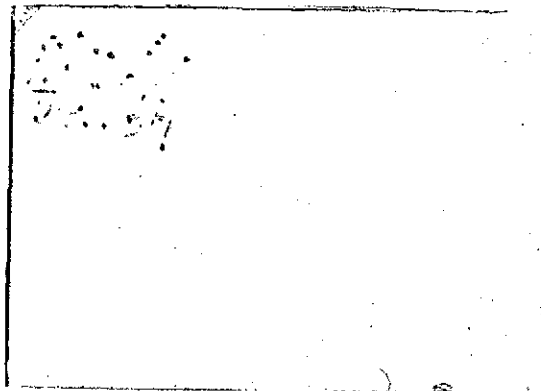


FIGURE 14
Gold Holder in Box
2 hours

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9. At the same time, a glass plate was inserted into both the 1-2 and the 2-2 carrousel without a holder. They were suspended in the aperture with paper clips and the room darkened throughout the test. After 2 hours they were removed and processed. The plate from the 1-2 carrousel was heavily fogged (Figure 15), while the one from the 2-2 carrousel was slightly fogged (Figure 16).



FIGURE 15
Carrousel 1-2
No Holder
2 hours

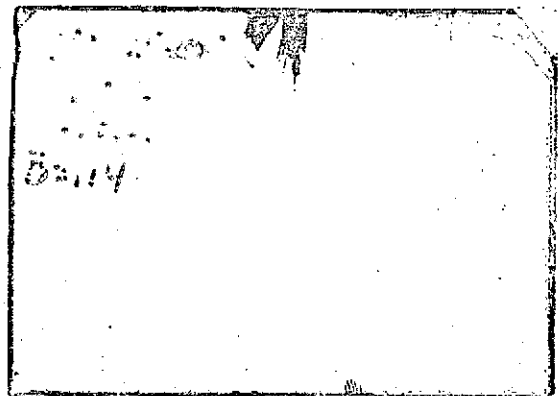


FIGURE 16
Carrousel 2-2
No Holder
2 hours

This follows the pattern established previously which showed the 1-2 carrousel had more fogging effect than the 2-2 carrousel.

10. As a continuation of the testing showing long term effects, a glass plate was removed and processed after

storage for twelve hours from both the 1-2 carrousel (Figure 17) and the 2-1 carrousel (Figure 18).

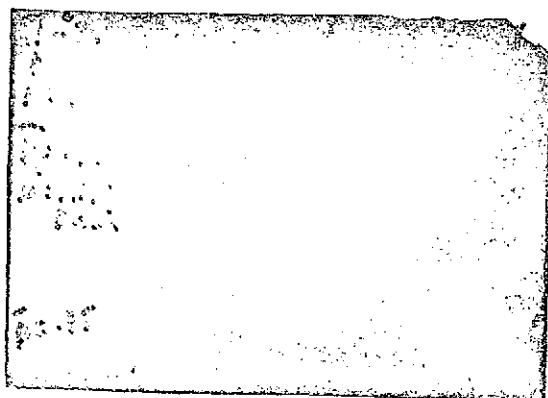


FIGURE 17
Carrousel 1-2
12 hours

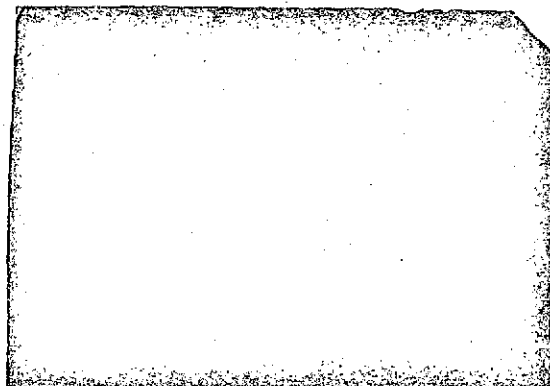


FIGURE 18
Carrousel 2-1
12 hours

The heavier fogging in the 2-1 carrousel was unexpected, since this carrousel had shown less fogging effect in previous tests than the 1-2 carrousel.

11. To determine if the fog was enhanced when two plates were stored side-by-side in the carrousel, plates were placed in the 2-2 carrousel in position 1 (Figure 19) and Position 2 (Figure 20), left for 12 hours, removed and processed.

The results were inconclusive.

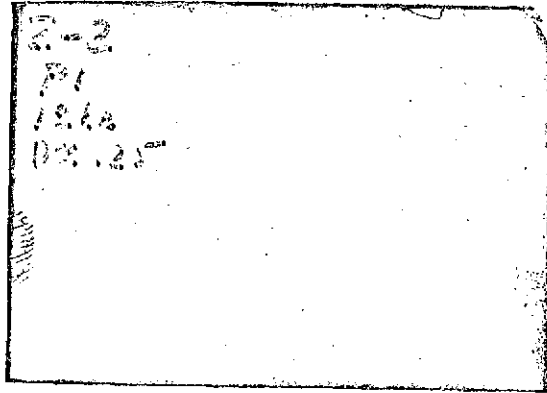


FIGURE 19
Carrousel 2-2
Position 1
12 hours

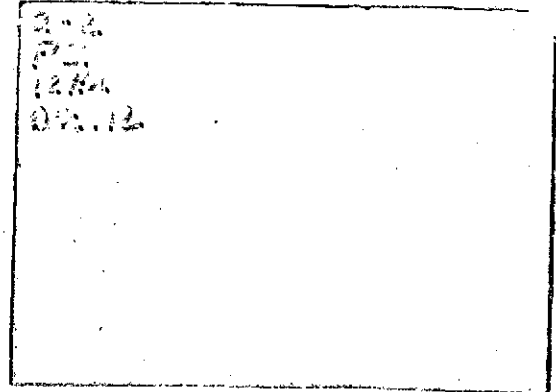


FIGURE 20
Carrousel 2-2
Position 2
12 hours

12. To help determine if the fogging was due to an outgassing of some type, a plate was sealed in a plastic bag and then inserted into the 2-1 carrousel. A second plate was loaded normally into the carrousel to be used as a control. After 3 hours the plates were removed from the carrousel and processed. Both plates were essentially clear. The plate stored without the plastic bag (Figure 21) had slightly more fogging than the plate stored in the plastic fog (Figure 22).

The test was inconclusive, because the control plate did not come close to having the same amount of fogging as experienced previously with this carrousel. (See Figures 8, 13, and 18).

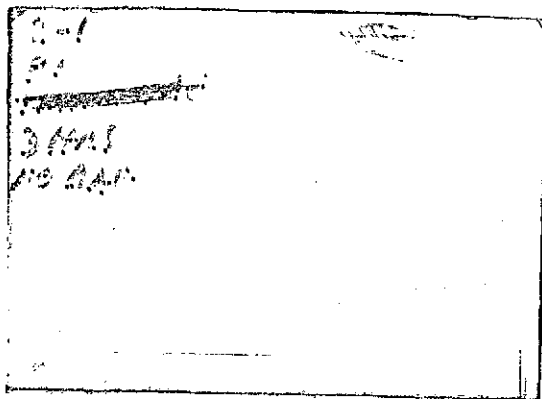


FIGURE 21
Carrousel 2-1
Position 1
No Plastic Bag
3 hours

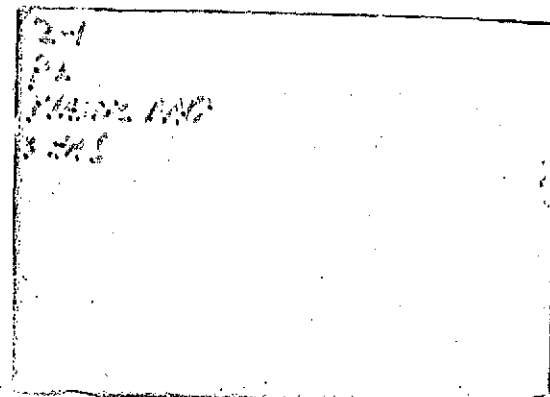
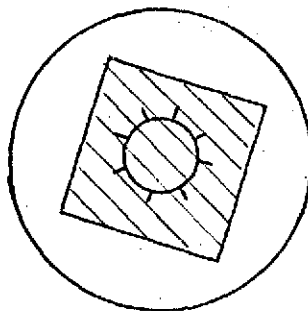


FIGURE 22
Carrousel 2-1
Position 2
With Plastic Bag
3 hours

13. The 2-1 carrousel was partially disassembled, and 4 glass plates were placed on various parts of the carrousel to determine if one part caused more fogging than another. The positions are as follow:

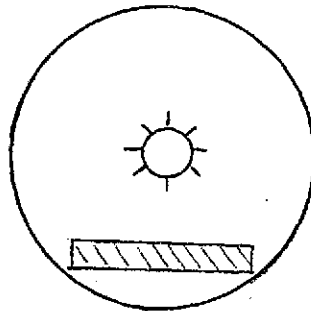
Position 1. Glass plate placed, emulsion down, on top of central aluminum fins.



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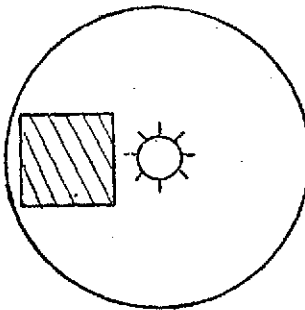
(See Figure 23)

Position 2. Glass plate placed, emulsion facing outward, leaning against brass tracks only.



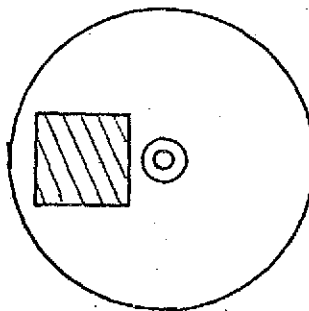
(See Figure 24)

Position 3. Glass plate laying, emulsion down, between aluminum central fins and brass outer tracks.



(See Figure 25)

Position 4. Glass plate positioned, emulsion down, entirely on anodized aluminum cover.



(See Figure 26)

After 3 hours the plates were removed and processed. Positions 1 and 3 showed the most fogging effect. The plate located in position 3 shows a sharply defined clear area in the center with fog on the rest of the plate. It was decided that this test should be conducted again, however, the plates should be left positioned for twelve hours.

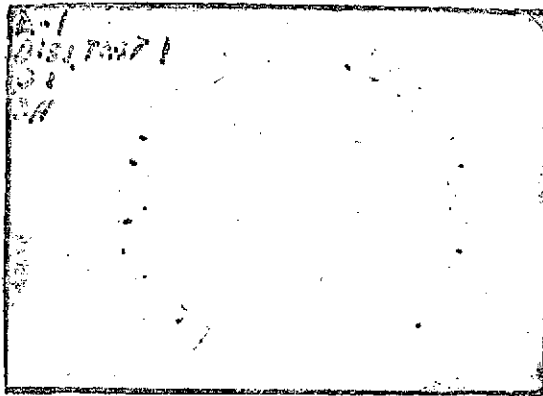


FIGURE 23
Carrousel 2-1
Position 1
3 hours

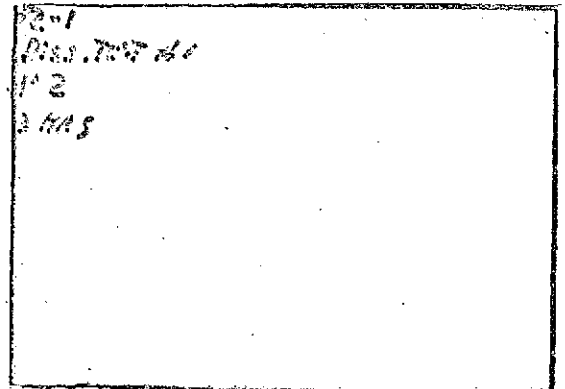


FIGURE 24
Carrousel 2-1
Position 2
3 hours

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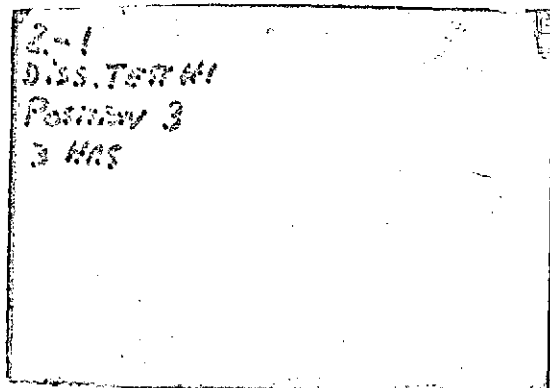


FIGURE 25
Carrousel 2-1
Position 3
3 hours

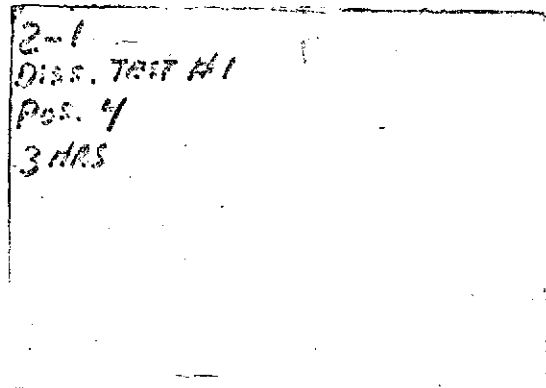
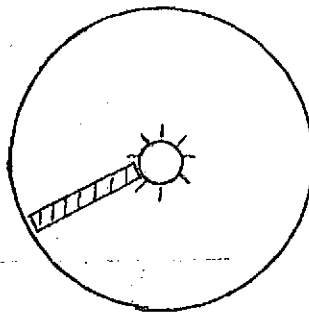


FIGURE 26
Carrousel 2-1
Position 4
3 hours

14. Five glass plates were placed in the following positions:

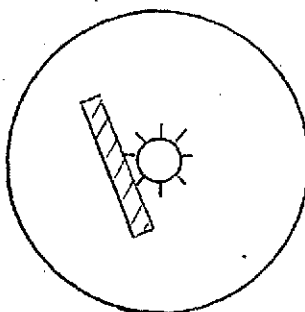
Position 1. Glass plate placed in normal orientation, supported by the aluminum fins on one end and the brass track on the other end.



(See Figure 27)

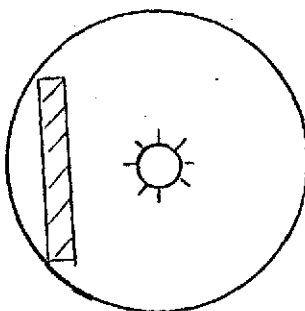
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Position 2. Glass plate leaning against aluminum fins,
emulsion facing central tube.



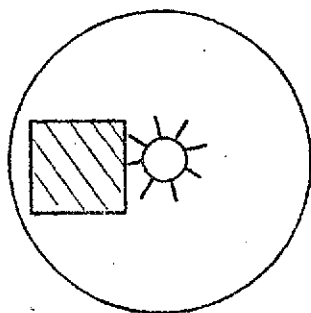
(See Figure 28)

Position 3. Glass plate, emulsion facing outward,
leaning against brass tracks only.



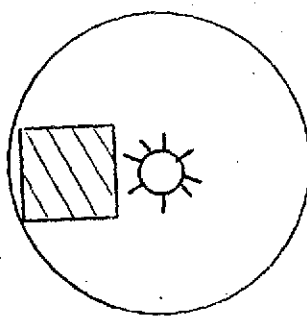
(See Figure 29)

Position 4. Glass plate, laying emulsion down, between aluminum central fins and brass outer tracks.



(See Figure 30)

Position 5. Plate was positioned, emulsion down, on anodized aluminum base.



(See Figure 31)

For this test, the carrousel was reassembled and placed in its container. After 12 hours, the carrousel was disassembled; the plates were removed and processed.

The plates all showed minimal fogging. In particular, no pattern was evident like that seen in the previous test. This lack of fog, even after twelve hours in a carrousel which had fogged heavily in previous tests, gave a strong indication that the fog was caused by some type of slow outgassing.

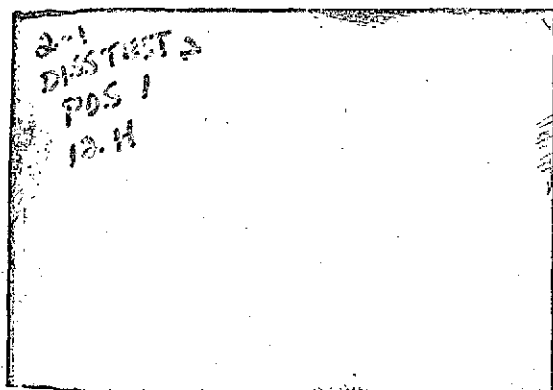


FIGURE 27
Carrousel 2-1
Position 1
12 hours

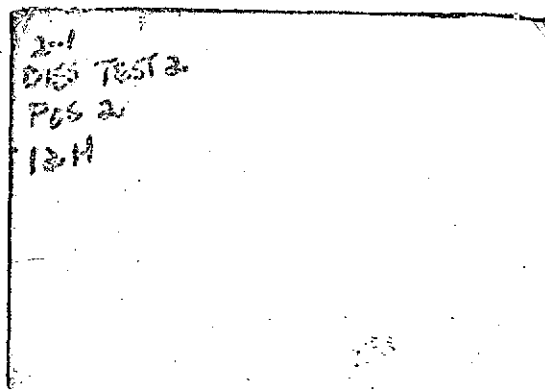


FIGURE 28
Carrousel 2-1
Position 2
12 hours

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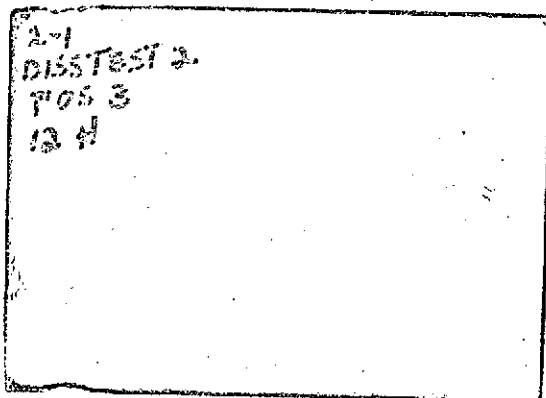


FIGURE 29
Carrousel 2-1
Position 3
12 hours

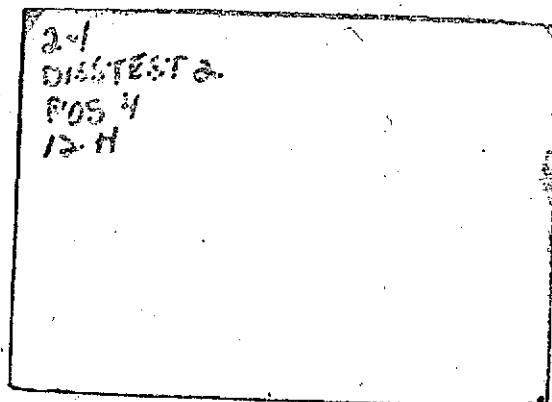


FIGURE 30
Carrousel 2-1
Position 4
12 hours

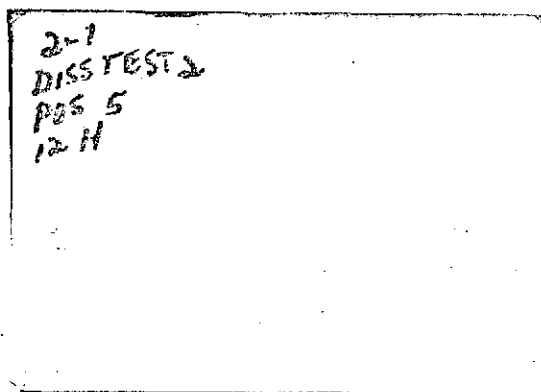


FIGURE 31
Carrousel 2-1
Position 5
12 hours

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15. An additional light leak test was conducted. Two glass plates were placed in carrousel 2-1, one in position #1 (Figure 32) and one in Position #15 (Figure 33).

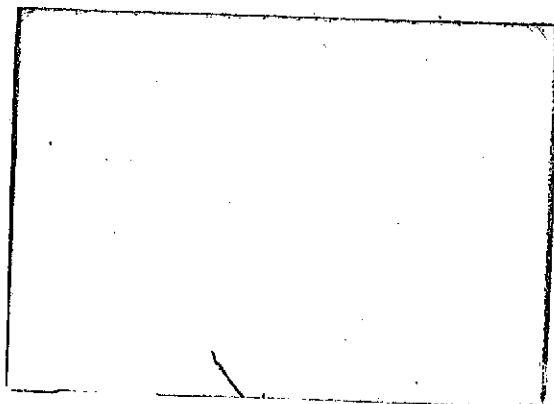


FIGURE 32
Carrousel 2-1
Position 1
Light Leak Test

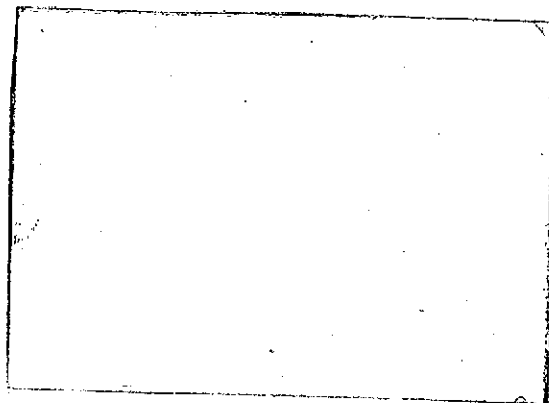


FIGURE 33
Carrousel 2-1
Position 15
Light Leak Test

A 375-watt flood lamp was moved continuously over all areas of the carrousel for 5 minutes. The plates were removed and processed. No fogging was evident.

16. While the previously described tests were being conducted, the 1-2 and 2-2 carrousels were being subjected to a gas analysis. The analyses showed traces of Freon 113 inside the carrousels. This was the chemical under the trade name, "Flugene", used in France to clean the carrousel. Freon 113 (500 ppm) was added to

a container of nitrogen. This gas was leaked into a cardboard box containing a 101-05 glass plate for approximately 3 minutes, and the plate subsequently processed. There was no fog evident on the plate (Figure 34).

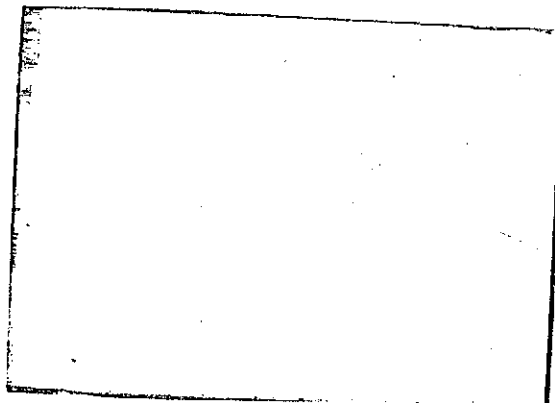


FIGURE 34
Freon Test

III. CONCLUSION

Based on the tests which were conducted, the fogging exhibited by the Kodak 101-05 glass plates when used in the S-183 experiment carrousel, serial # 1-2, 2-1, 2-2, is a chemical fog caused by an outgassing within the carrousel. The testing has not yet been able to determine which chemical causes the fog or what can be done to eliminate the problem.